Status of the new wind tunnel

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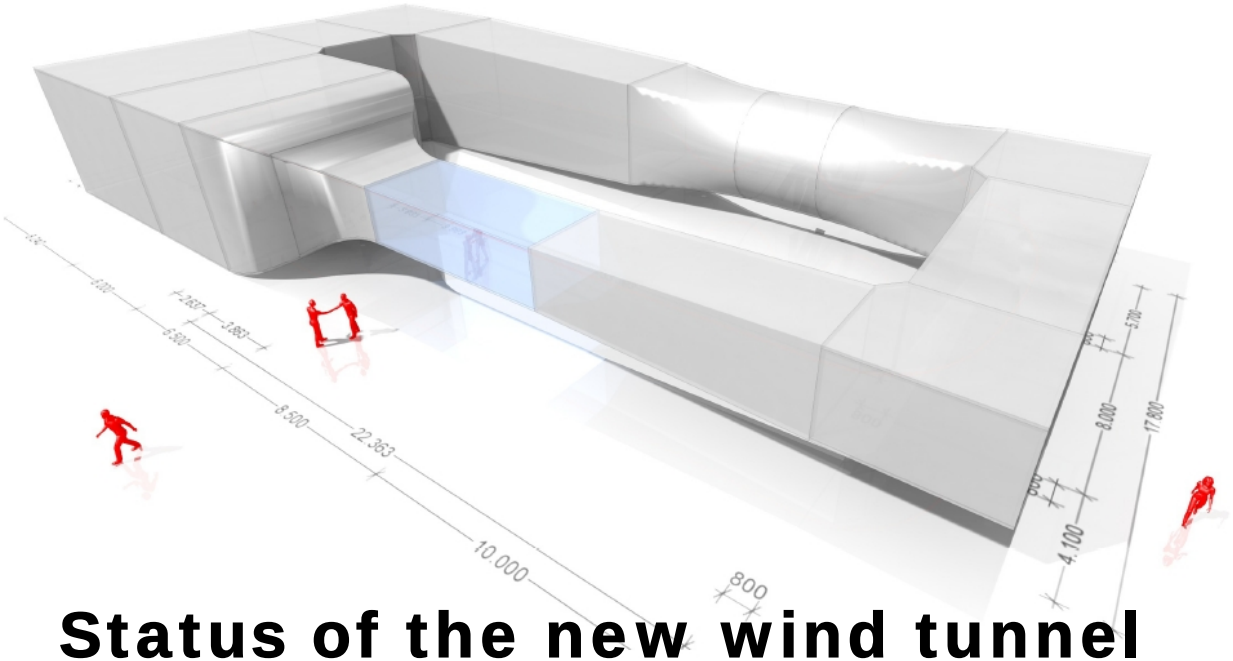

Status of the new wind tunnel

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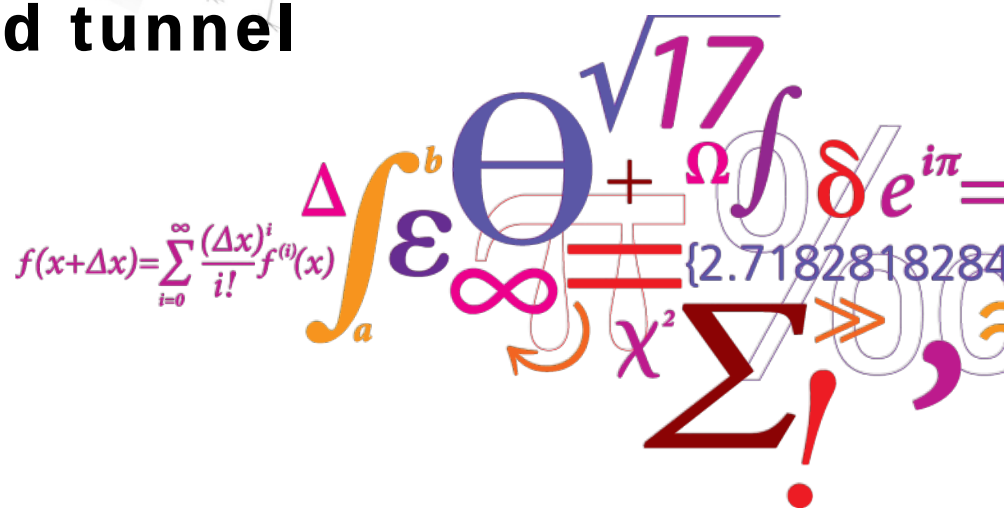
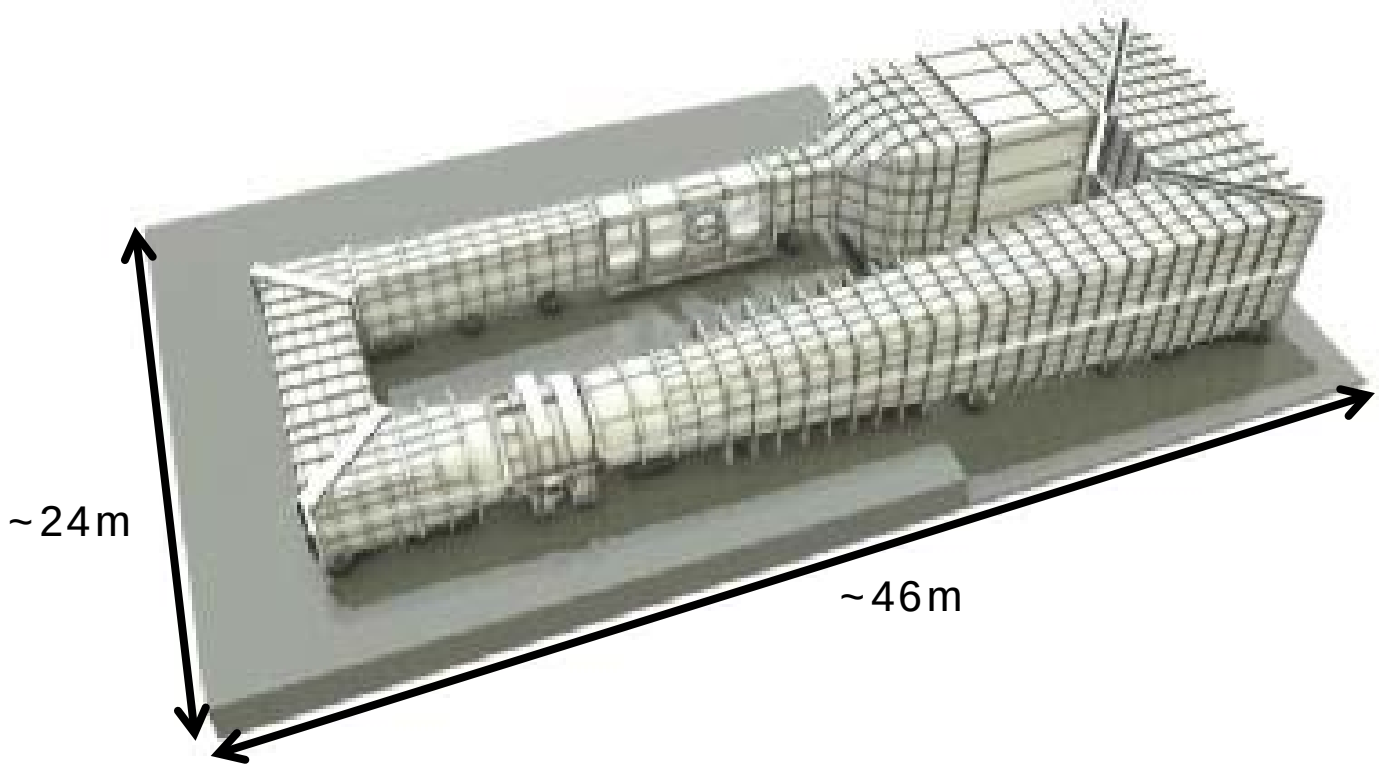


DTU Wind Energy
Department of Wind Energy

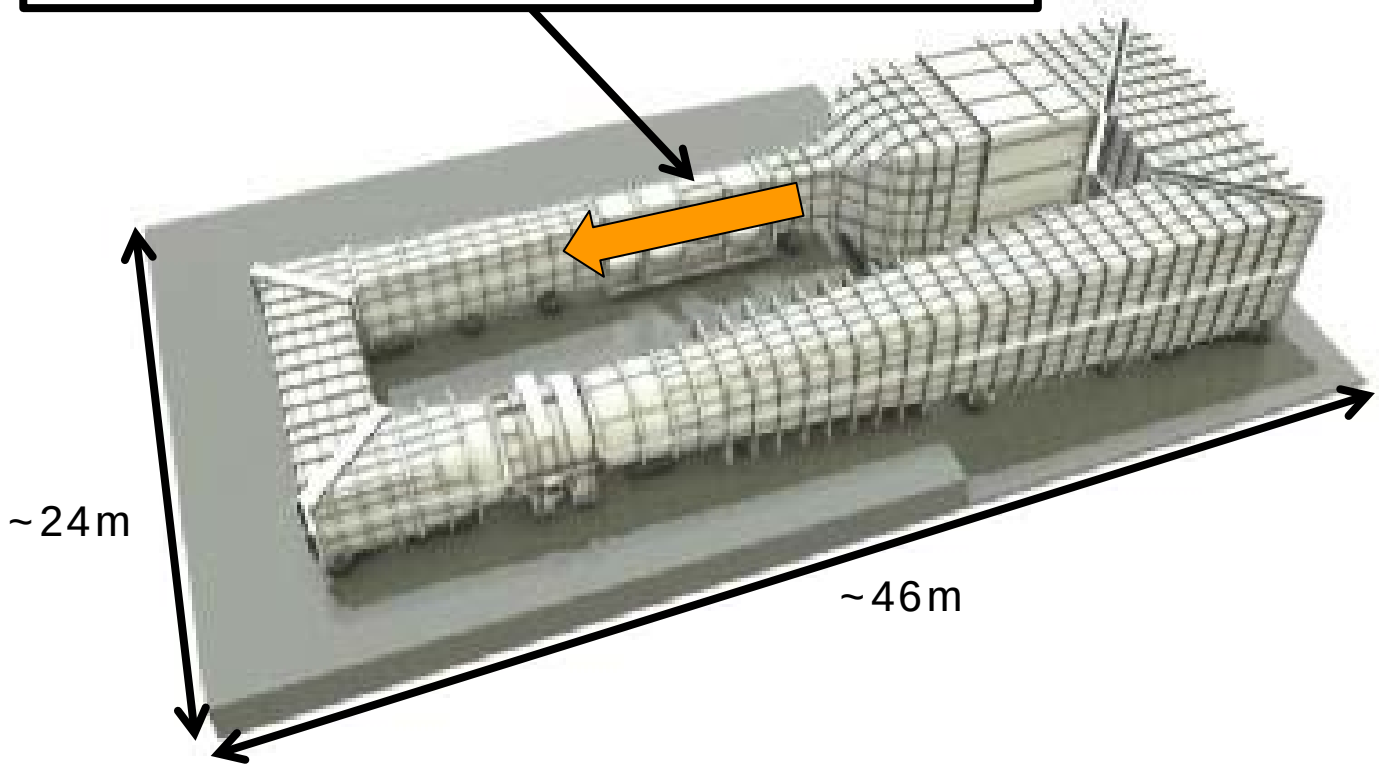
What is a wind tunnel?



LM Wind Power vindtunnel, Lunderskov, Denmark

What is a wind tunnel?

Test section
Wing section mounted
Flow up to 380km/h and very low turbulence



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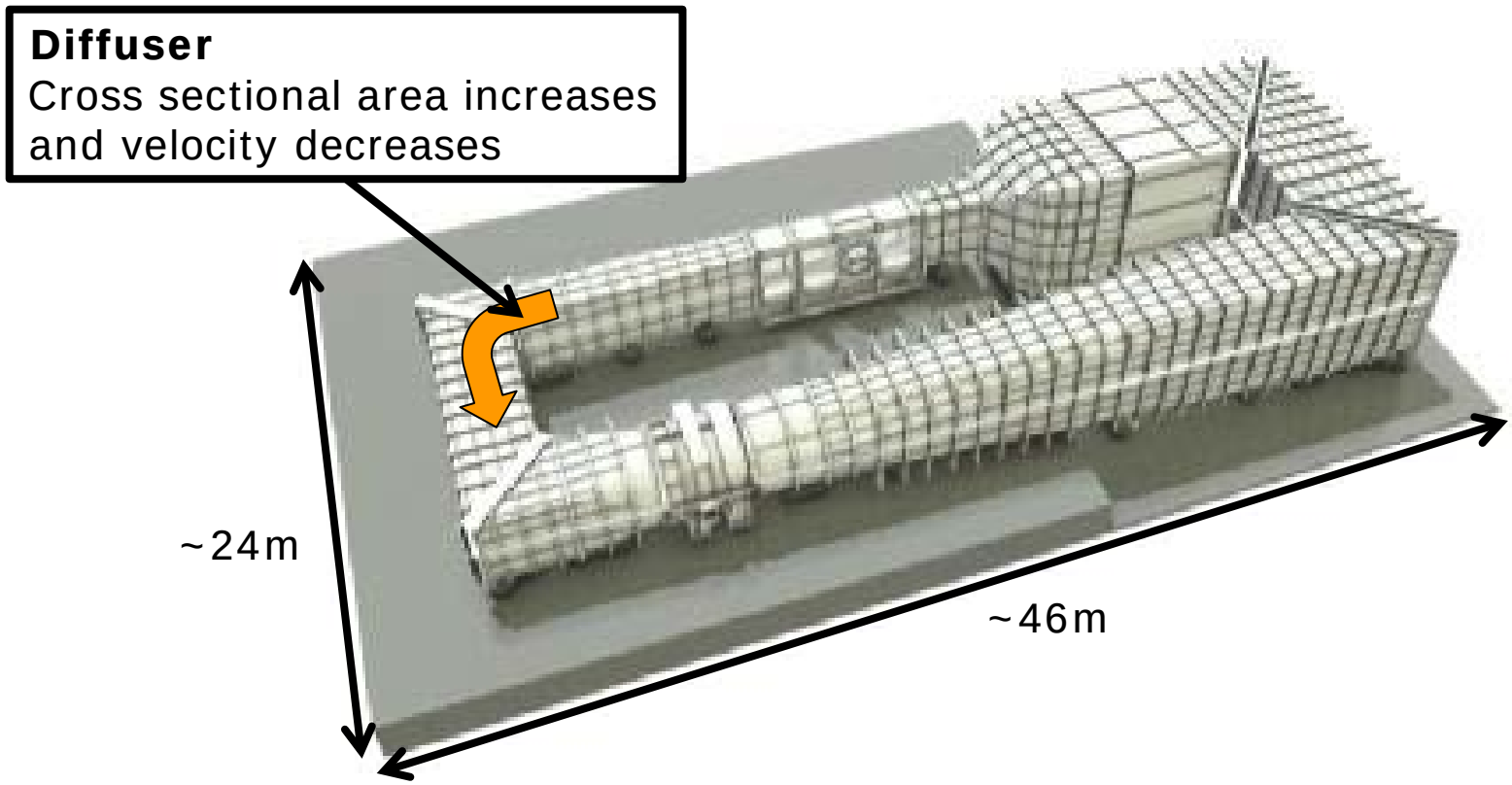

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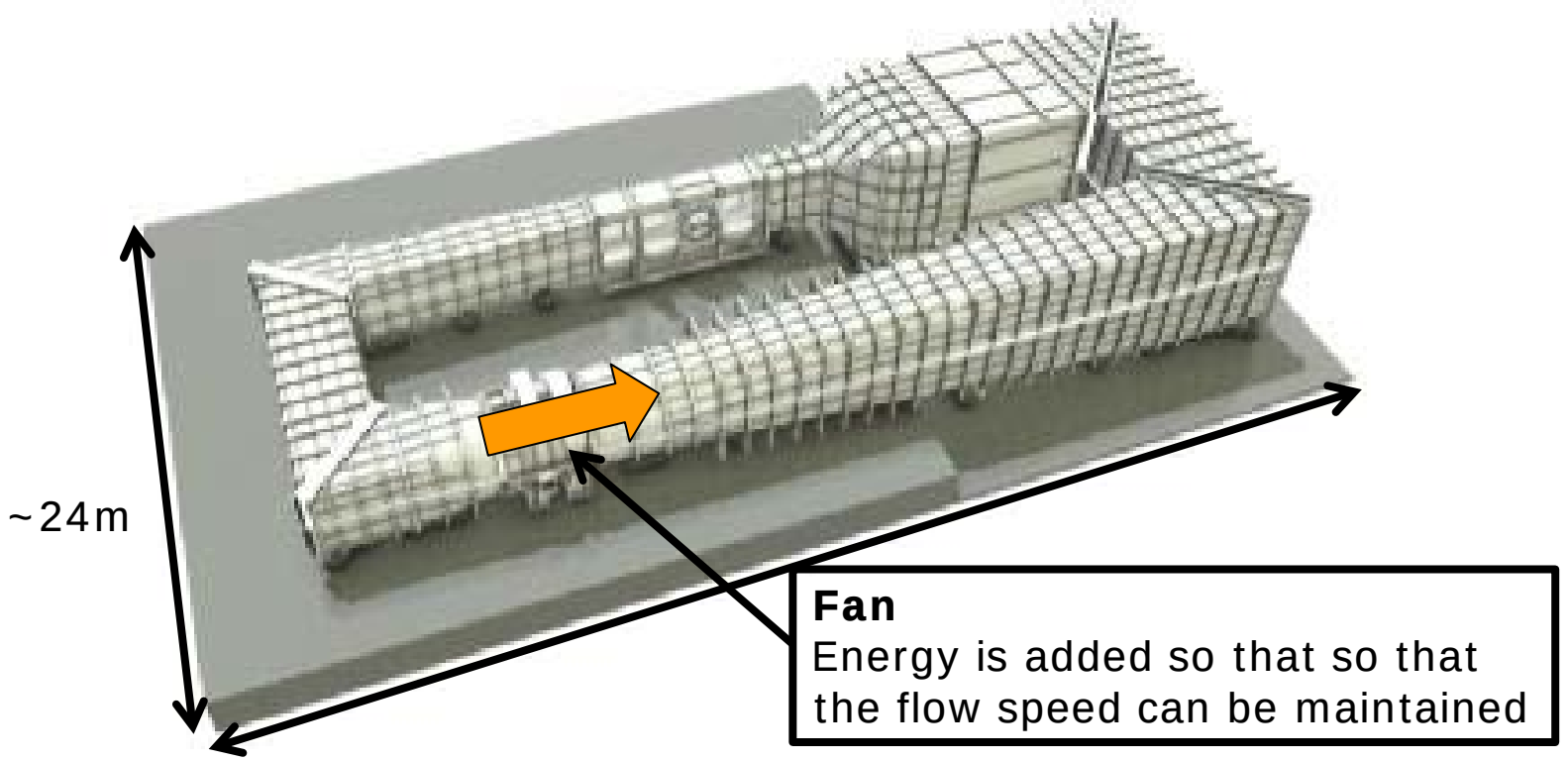

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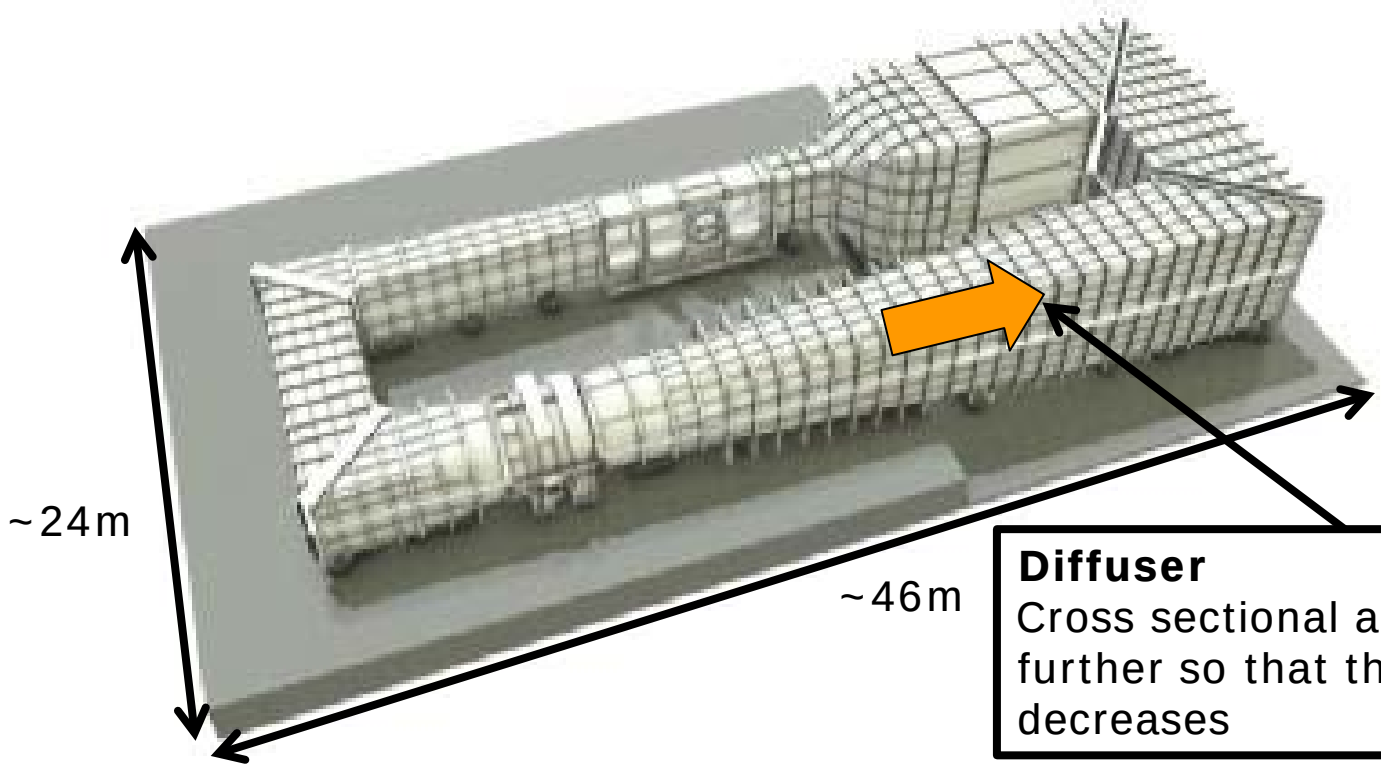

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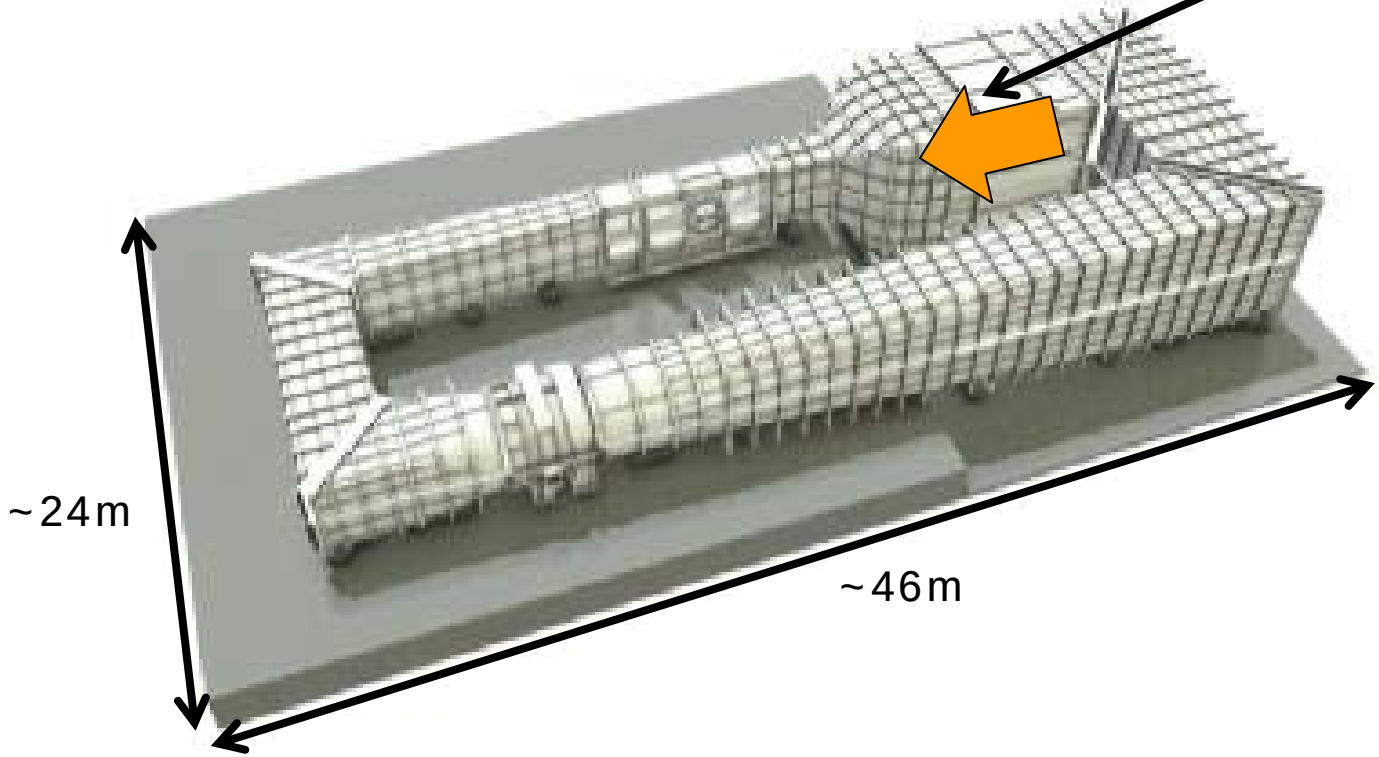
What is a wind tunnel?

Settling chamber
Cross sectional area is maximum and constant. Velocities are here minimum. Here the flow is cooled and different screens reduce the turbulence



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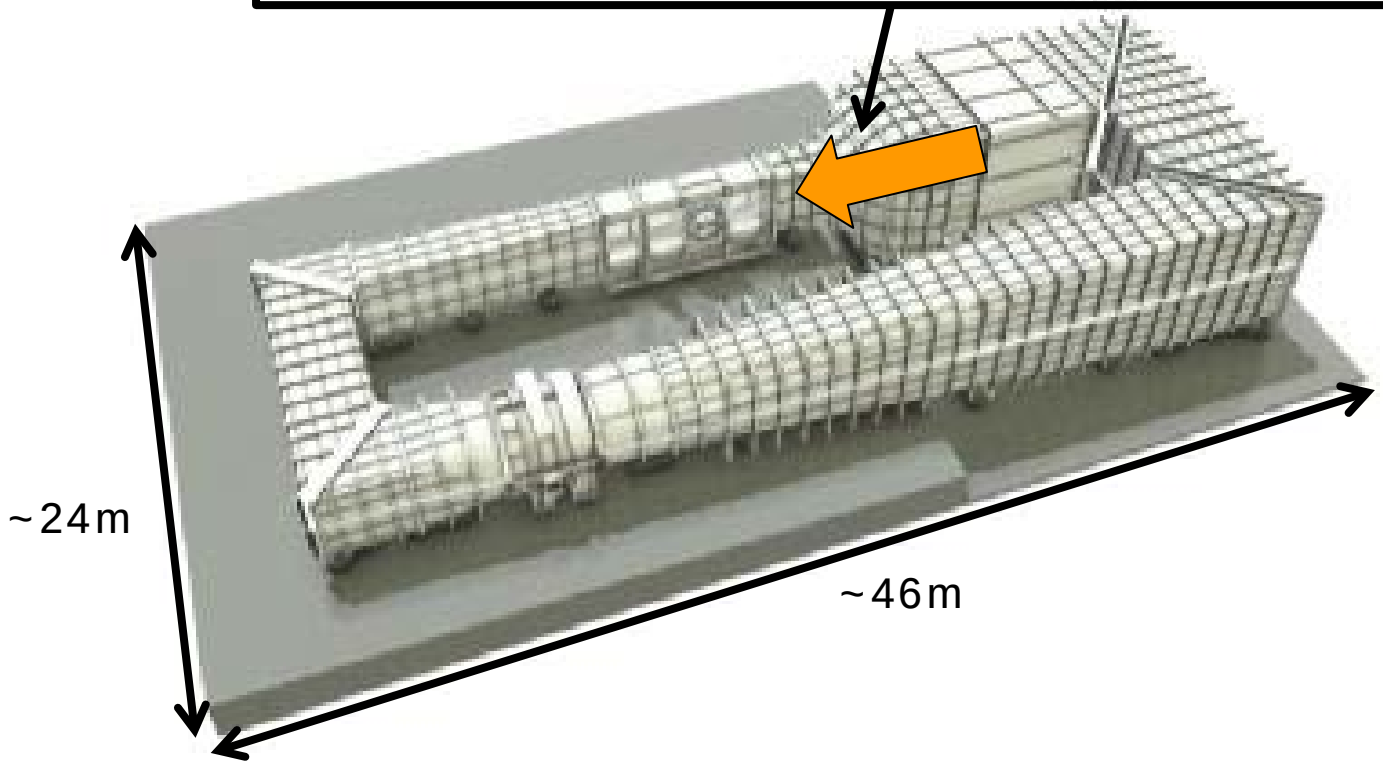
What is a wind tunnel?

Contraction
Cross sectional area reduces quickly and the velocity increases significantly towards the test section



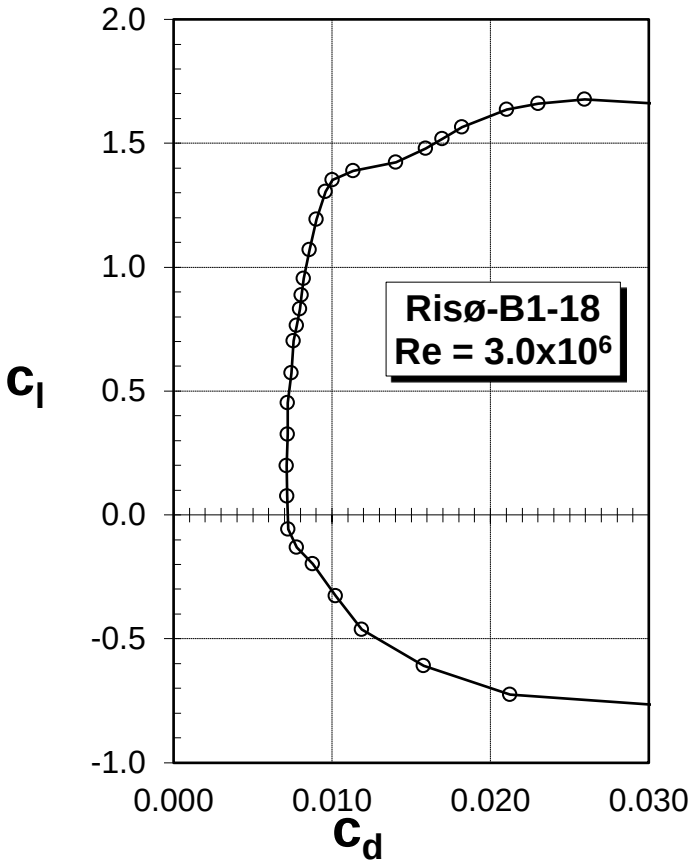
LM Wind Power vindtunnel, Lunderskov, Denmark

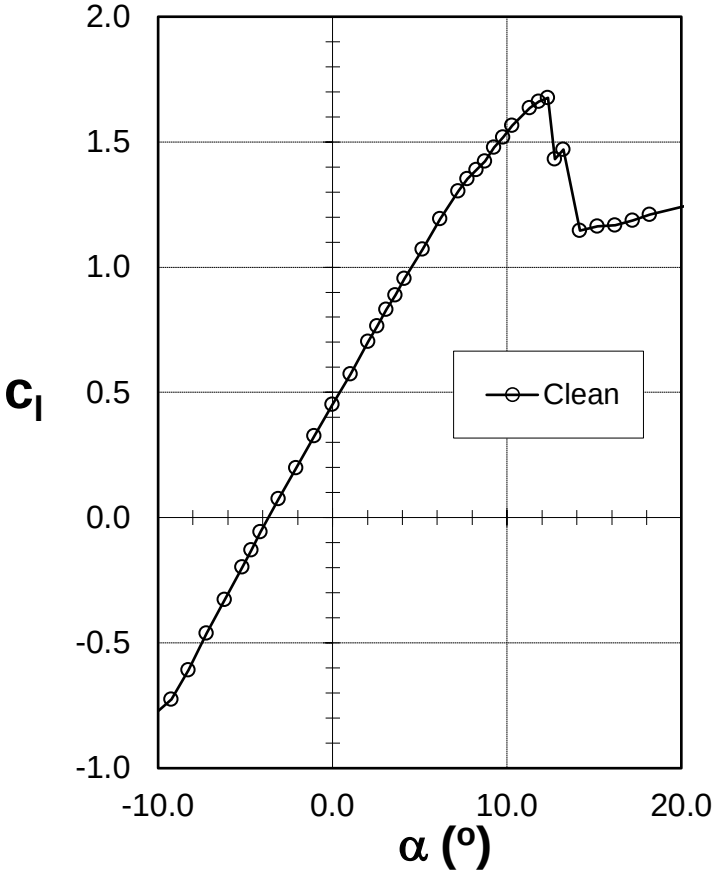
What a wind tunnel can be used for
Wing section / airfoil design

- Airfoils have been designed by DTU Wind Energy and some are applied by the industry
  1. Roughness insensitive
  2. High aerodynamic efficiency
  3. Structural stiffness
  4. High compatibility between airfoils
  5. Low noise

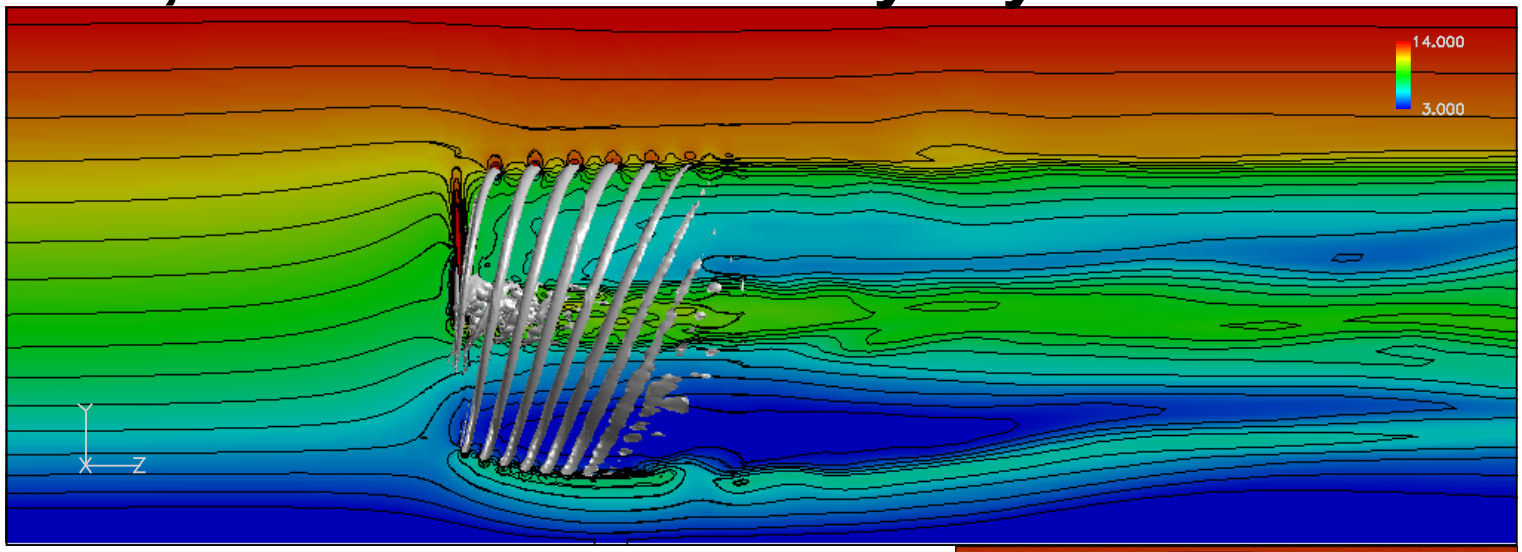
What a wind tunnel can be used for Wing section / airfoil design

One of the results from a test of an airfoil

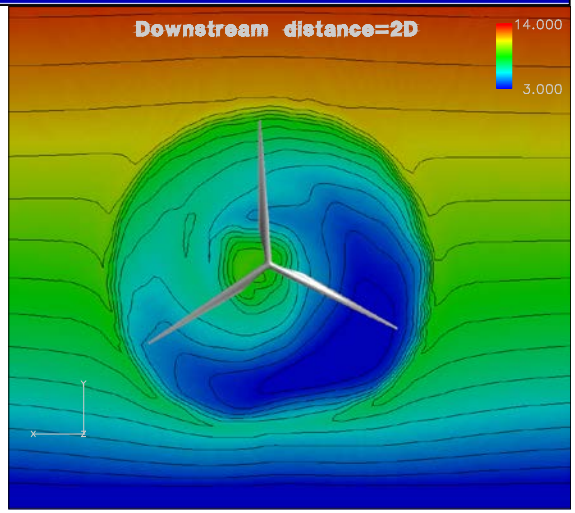




What a wind tunnel can be used for
Rotor, wake and boundary layer flow



Results from Computational Fluid Dynamics (CFD), EllipSys3D, a simulation tool dedicated wind energy



History of the new National Wind Tunnel (1)

- **June 2010**: In connection to the Ministry of Science's preparation of a roadmap for research infrastructure, DTU applied for a large wind tunnel

- **April 2011**: The wind tunnel was selected as one out of six research infrastructures, if DTU could find national support

- **December 2011**: A project description was submitted to the Ministry of Science, where the Danish wind turbine industry and the universities agreed that there is a need for a large tunnel and that it should be placed at DTU Risø Campus to the cost of 66mio DKK

- **May 2012**: 40mio DKK was granted the wind tunnel by the Ministry of Science

- **June 2012**: 4mio DKK was granted by Region Sjælland for the workshops

History of the new National Wind Tunnel (2)

- **May - August 2012**: Considerations of how to relate the project to procurement rules and how to carry out the project

- **August 2012**: Kick-off of project together with Alectia who is DTU's consultancy company. The project was organized
  - so that the project management is handled by 3 persons – each from Alectia, DTU CAS (Allan Murphy) and DTU Wind Energy (Christian Bak)
  - with a steering committe, which the project management refers to, consisting of e.g. Peter Hauge and Henrik Wegener (Provost)
  - so that different groups can be involved from time to time, e.g. internal DTU person and persons from the industry

- **August – November 2012:**
  - Meetings with interested parties at DTU about the wind tunnel specifications
  - The wind tunnel design company Jacobs made a first draft design
  - Further organization of the project and detailed planning incl identification of bottle-necks

Requirements for main specifications

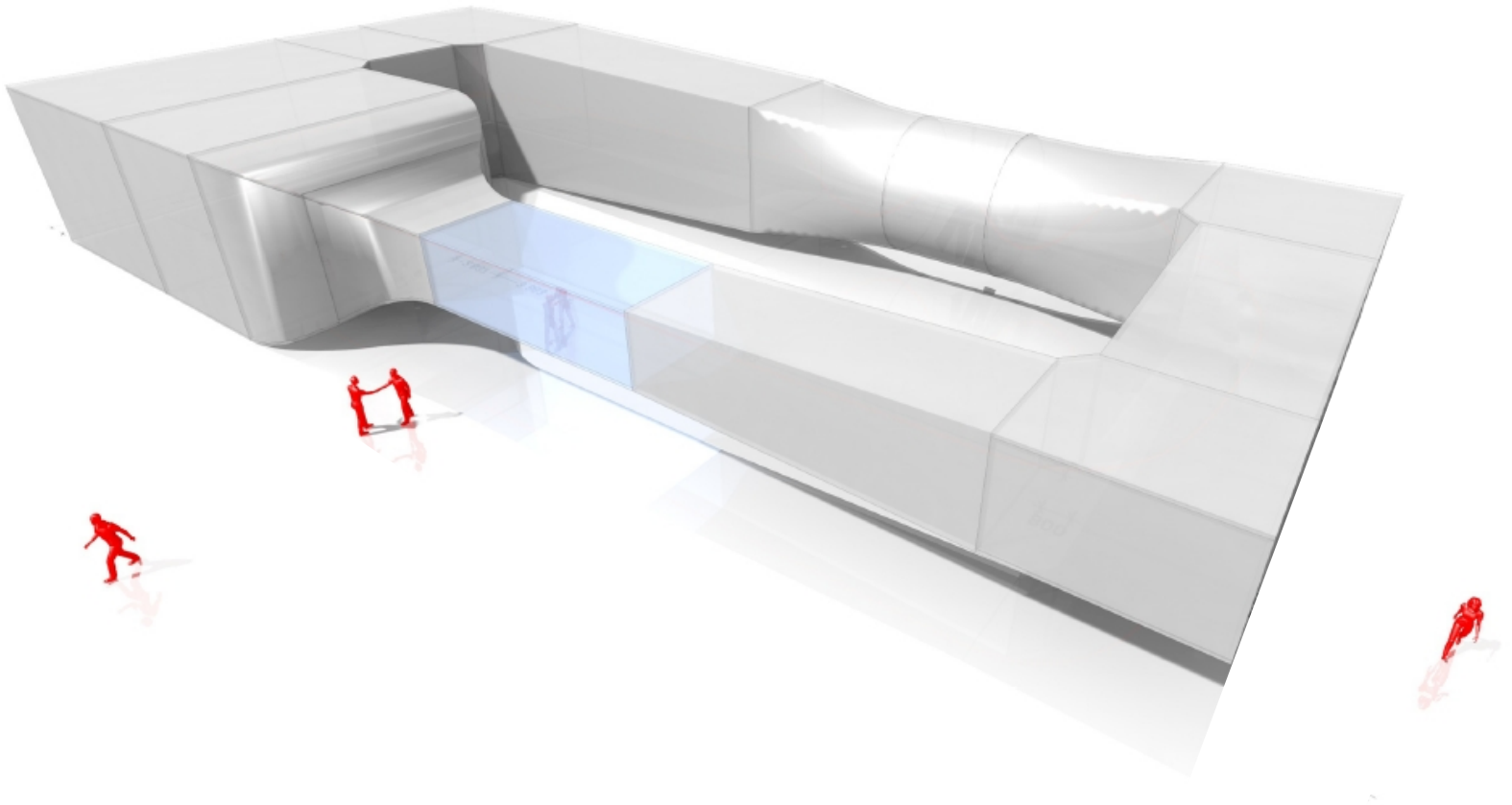
- ***1. priority:***
  - Aerodynamics on airfoils at Reynolds numbers between 6 and 8 million
  - Thick airfoils and airfoils with high lift
  - Thin airfoils with light compressible flow
  - Aeroacoustics on airfoils
- ***2. priority:***
  - Model rotors, wakes after rotors and boundary layers with different shears
- **3. priority**
  - Climatic tests

- We are right now only focusing on 1. priority because we suspect the budget to be insufficient to hold both 1. and 2. priority

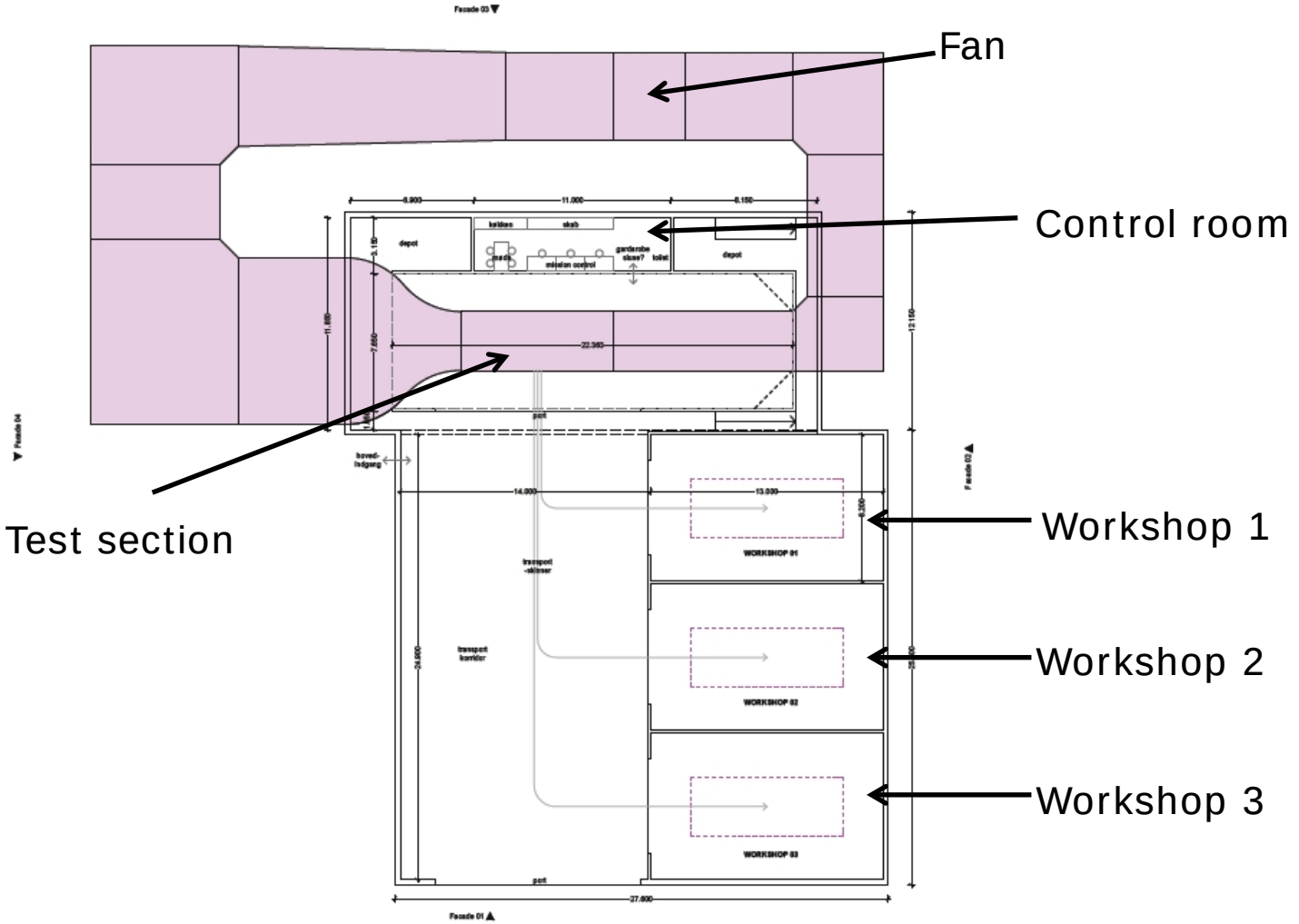
Wind tunnel specifications for airfoil tests

Description	Value
Design Reynolds number [-]	6.0×10^6
Design chord length [m]	1.10
Design flow speed [m/s]	82
Maximum flow speed [m/s]	~105
Vertically/horizontally placed airfoil	Vertical
Test section: Width x Height x Length [m]	3.30 x 2.20 x 8.5
Possibility for exchanging test sections	Yes
Max turbulence intensity [%]	Max 0.1
Anechoic chamber with background noise at 60m/s with kevlar walls 2m from airfoil [dB]	<70
Design flow speed for acoustic measurements [m/s]	60
Constant temperature [°C]	25
Gust generator	No
Turbulence generator	Yes
Easy workflow	Yes

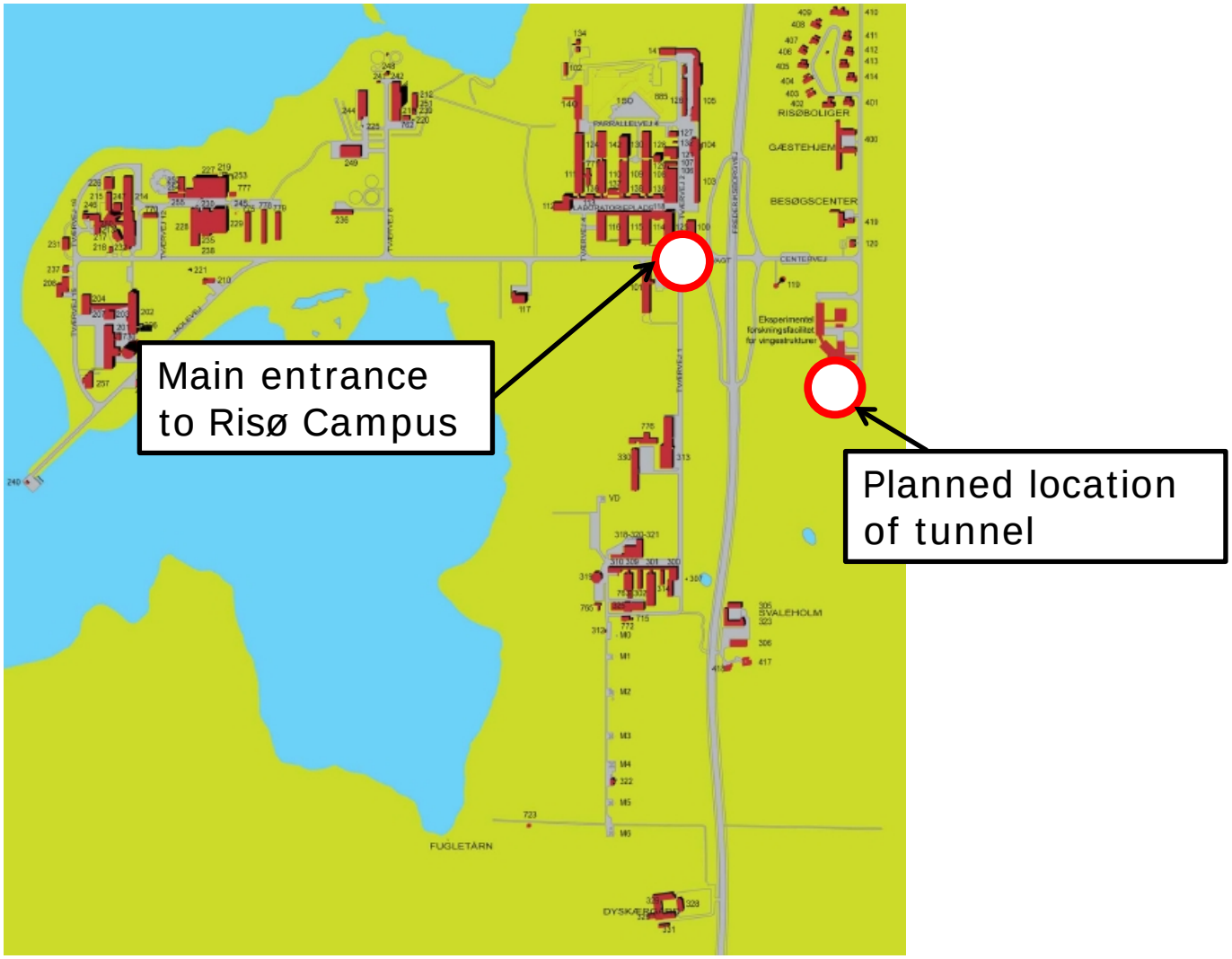
A sketch of the wind tunnel



Another sketch of the wind tunnel

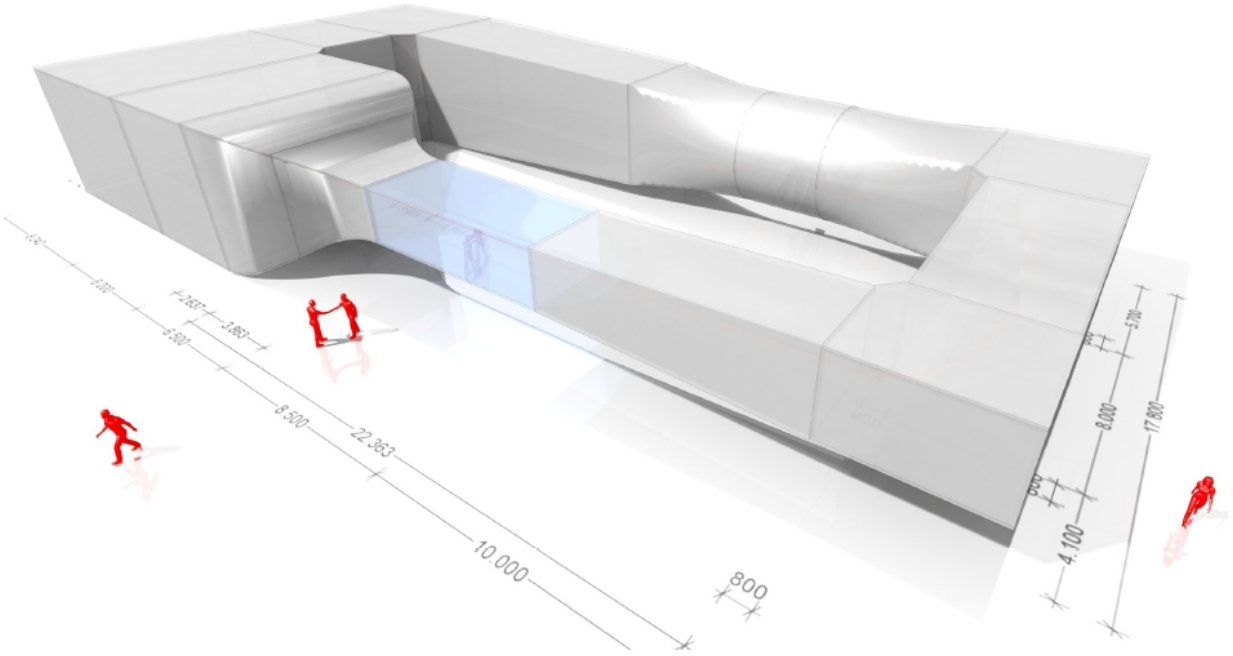


Where should the wind tunnel be located?



Status right now

- Design and construction of a wind tunnel is not a standard task
- Therefore, it has been a challenge to establish the design team including airline designer and an expert in aeroacostic design. It seems that this team is close to be formed
- A contractor will be involved before summer to be part of the detailed design
- A lot of different issues have been discussed – both technical and contractual – but no design of the tunnel exists yet
- The wind tunnel is expected established 2014



Tkank you for your attention!